

August 9, 1949

To: All Field Personnel
Applications and Loans Division

From: G. E. Dillon, Assistant Chief
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Subject: Water Softeners for Farm Use

Recently, one of our field home economists reported that one of the largest manufacturers of automatic washers is discouraging the use of mechanical water softeners because of their cost. Instead, this manufacturer recommends the use of certain proprietary washing compounds. Our field representative was disturbed because she had been recommending mechanical water softeners.

I asked Fred McVey and Earl Arnold to prepare a statement which would give you accurate information on the costs of mechanical softeners. Their statement is attached. After you have studied it I believe you will agree that ordinarily the overall annual cost to a farmer of using a mechanical water softener will be in the range of \$10.00 to \$25.00, while the annual operating cost will be in the range of \$5.00 to \$15.00. The person who rents a softener, as many city people do, may have considerably higher costs.

You will notice that no analysis is made of the saving in the cost of soap when a mechanical softener is used, or of the comparative costs with synthetic detergents or washing compounds. We lack the basic data from which to calculate these comparative costs.

Attachment

G. E. Dillon

Most water used in rural areas comes from wells, springs, ponds, lakes, or streams. Much of it is hard. Its hardness will vary greatly from source to source and from location to location. Wells a short distance apart and of the same general construction and depth may deliver water varying greatly in hardness.

There are three common ways of softening water for domestic use.

1. Using an excess of soap. (Suds will not be formed until enough soap has been added to soften the water).
2. Adding certain chemicals to the water.
3. Using mechanical water softeners.

How Mechanical Softeners Operate

Mechanical softeners are closed tanks filled with zeolite through which the water passes. The two main contributors of water hardness are calcium and magnesium carbonates. Through a chemical base exchange these are converted to sodium carbonate as the water passes through the zeolite. Sodium carbonate is of no practical significance in the water. Water containing it alone is soft water suitable for all usual household purposes.

Regeneration

Since the softener works by a base exchange of calcium and magnesium for sodium there is a limited amount of water that any specified quantity of zeolite can soften. When this amount of hard water has passed through the zeolite the sodium in the zeolite is exhausted. However, the chemical action is completely reversible. When common salt (NaCl) is placed in contact with the zeolite, the zeolite gives up the calcium and magnesium and replaces the sodium in its chemical structure so that it is again ready to soften water. The process of replacing the sodium in the zeolite is known as regenerating the softener.

Types of Softeners

Based on the method of servicing, we can divide softeners into two types:

- A. Home regenerated type.
- B. Zeolite exchange type.

A. Home Regenerated Type

The home regenerated type is owned outright by the property owners and is regenerated by the persons occupying the premises. Some of these are single unit softeners while others are double unit softeners.

1. Single unit softeners: A single unit softener has only one tank which contains the zeolite. It is regenerated by removing the top cover and adding salt to the zeolite. After the salt has been in contact with the zeolite for a period from 15 to 30 minutes it is flushed out and allowed to drain away.

2. Double unit softeners: A double unit softener has two tanks. One of these tanks contains the zeolite and the other contains a concentrated salt brine with an excess of undissolved salt in the bottom. The operator adds the salt to this second tank as it is needed. By proper manipulation of certain valves the operator allows the brine from the second tank to be forced through the zeolite in the main tank for the regeneration process. Some expensive models are equipped with meters and time clocks which automatically do the regenerating after predetermined amounts of water have passed through the softeners.

B. Zeolite Exchange Type

The zeolite exchange type may be the same identical machine as the home regenerated type. The essential difference is that some commercial concern does the regeneration. Since it depends on regular attention by commercial servicemen it is far more suited to urban than to rural use. Two methods of servicing are used:

1. The softener is rented to the property owner and is connected to the water system by readily disconnected flexible water connections. At regular predetermined intervals of time the serviceman removes the softener and replaces it with one that has been regenerated. He then takes the original softener to his headquarters where it is regenerated and then delivered to someone else's home for use again.
2. The softener is rented to the property owner but is connected to his water piping by permanent connections. The zeolite in the softener is in cloth bags. At regular predetermined intervals of time the serviceman takes out the bags of zeolite and replaces them with other bags of zeolite that have been regenerated at his headquarters. The bags that he has removed are then taken to his headquarters and regenerated for use elsewhere. This method is not highly regarded by health authorities because of the possibility of introducing contamination into the water system when the softener is opened and the bags of zeolite put in.

Measuring Water Hardness

The hardness of water is most commonly measured in terms of grains of calcium and magnesium carbonate per gallon. There is no universal standard for determining whether water is soft or hard. In an area where most of the waters are very hard, one with only 8 to 10 grains of hardness may be considered soft. In another area of predominantly soft waters, one with 5 grains of hardness may be considered hard. In general, the following guide will be fairly acceptable:

0 to 4 grains ----- Soft
 5 to 7 grains ----- Moderately hard
 Over 7 grains ----- Hard

Waters with more than 50 grains of hardness are sometimes found but are quite unusual. Twenty to 30 grains of hardness are common.

Water Softener Sizes

Commonly the sizes of softeners are designated by their capacity to remove hardness. One which will remove 20,000 grains of hardness between regenerations is known as a 20,000 grain softener. The three most common sizes are 20,000 grains, 40,000 grains, and 60,000 grains. The number of gallons of water that a softener will handle between regenerations depends on the size of the softener and the hardness of the water. For example, if the water is 10 grains hard and we have a 20,000 grain softener, 2,000 gallons can be softened between regenerations. Generally, it is best to have a softener that with normal usage will not need regeneration oftener than twice a month. The correct size of softener to buy is determined by three factors:

- a. Hardness of the water
- b. Rate of use of soft water
- c. Time between regenerations

Costs of Zeolite Exchange Softeners

Since these softeners are rented, the user has no capital investment beyond a probable plumber's charge of about \$20.00 or more for altering the piping in his house for the connections to the softener. Rents usually run from \$2.75 to \$5.00 per month. This gives an annual rent of from \$18.00 to \$60.00.

Costs of Home Regenerated Softeners

1. Purchase price and installation costs

Each manufacturer has his own variations in design and there is considerable variation in prices. However, the following prices can be considered typical:

<u>Size</u>	<u>Single Unit</u>	<u>Double Unit</u>	<u>Installation Cost</u>
20,000 grain	\$65.00 to \$100.00	\$75.00 to \$110.00	\$20.00
40,000 grain	\$85.00 to \$135.00	\$90.00 to \$155.00	\$20.00
60,000 grain	\$110.00 to \$180.00	\$150.00 to \$200.00	\$20.00

2. Operation costs

The cost of operation will depend on:

- a. The hardness of the water
- b. The amount of water softened
- c. The price of salt

The following table gives the approximate amounts of salt required for each regeneration:

<u>Size of Softeners</u>	<u>Amount of Salt</u>
20,000 grains	10 to 12 lbs.
40,000 grains	20 to 24 lbs.
60,000 grains	30 to 35 lbs.

If salt costs 2 cents per pound and the softeners require regeneration twice a month, the following table gives the annual cost of salt:

<u>Size of Softeners</u>	<u>Annual Cost of Salt</u>
20,000 grains	\$4.80 to \$5.76
40,000 grains	\$9.60 to \$11.52
60,000 grains	\$14.40 to \$16.80

The life of zeolite is almost unlimited if it is properly selected to fit the chemical composition of the water. For practical purposes its normal life is figured at approximately 20 years.

3. Overall costs

If we assume the life of a softener and its zeolite to be 20 years, and if we accept the above costs for salt for regeneration, we get the following annual capital and operating costs for home regenerated softeners:

<u>Size of Softener</u>	<u>Annual Cost</u>	
	<u>Single Unit</u>	<u>Double Unit</u>
20,000 grains	\$9.05 to \$10.76	\$9.55 to \$12.26
40,000 grains	\$14.85 to \$19.27	\$15.10 to \$20.27
60,000 grains	\$20.90 to \$26.80	\$22.90 to \$27.80

Softened Water

A. Soap

Soap will soften water. As soap is added to hard water, permanent suds will not be formed until the water is softened. This is the reason that hard water requires the use of more soap than soft water. In the softening process the soap reacts with the hardness in the water to form a sticky, insoluble curd. It is this sticky curd that makes the ring on the bathtub. When this curd is formed in fabrics it cannot be completely washed out. It discolors the fabrics and causes them to deteriorate.

B. Softening Chemicals

Various chemicals when added to water cause the hardness to precipitate out or change the chemical form of the hardness so that it is no longer objectionable. These chemicals are sold under a wide variety of trade names in grocery stores and drug stores as washing compounds or bath salts. The most common chemical is trisodium phosphate.

Trisodium phosphate and some of the others produce an alkaline condition in the water that is drying to the skin and under some conditions may be irritating. A certain chemical may be irritating to one person but not to another. The active chemical used is generally not stated on the box or bag, and if it were, the average person could not interpret it in terms of the drying or irritating effect on his skin. For this reason, the general use of these proprietary water softening chemicals for bathing is questionable. In many homes, the annual cost of using these chemicals exceeds the cost of a mechanical water softener.

C. Mechanical Softeners

The mechanical softeners change the calcium and magnesium carbonates to sodium carbonate. This leaves soft water with sodium carbonate in solution. The sodium carbonate is not objectionable for any ordinary use. It has no taste or odor.

People who are accustomed to drinking hard water from their own wells have usually developed a liking for the taste of that water. The softener removes the tastes that are due to the hardness, and therefore the softened water may taste flat and not as desirable. Many families will want a third faucet at the kitchen sink supplying hard water for drinking.

When a mechanical softener is installed a careful study and possible rearrangement of the pipes in the water system should be made. This is to prevent the softening of water that does not need softening. If the water is only moderately hard, it is sometimes desirable to soften only the water that is heated. Mixtures of hot and cold water may then be soft enough to be unobjectionable. Water used for water closet flushing, stable cleaning, lawn watering, garden watering, and other purposes for which soft water has no advantages should not be softened. In watering the lawn or garden, enough soft water may be used in a single day to require regeneration of the softener.

